

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)	
)	
Request For Declaratory Ruling on the)	DA 98-2129
Use of Orthogonal Frequency Division)	
Multiplexing Modulation by Multipoint)	
Distribution Service and Instructional)	
Television Fixed Service Stations)	

DECLARATORY RULING AND ORDER

Adopted: March 19, 1999

Released: March 19, 1999

By the Chief, Mass Media Bureau:

INTRODUCTION

1. The Commission, by the Chief, Mass Media Bureau, acting pursuant to delegated authority, has before it a request for declaratory ruling filed by Clarity Wireless, Inc. ("Clarity") pursuant to Section 1.2 of the Commission's Rules, 47 C.F.R. § 1.2.¹ Clarity seeks approval for the regular use of Orthogonal Frequency Division Multiplexing Modulation ("OFDM") at stations operating in the Multipoint Distribution Service ("MDS") and the Instructional Television Fixed Service ("ITFS"). For the reasons set out below, we are granting Clarity's request and adding OFDM to the list of approved digital emissions for stations in these services.

BACKGROUND

2. On July 9, 1996, the Commission adopted a declaratory ruling² which permits stations operating in the MDS and ITFS services to utilize certain digital emissions on a regular basis, so long as those emissions meet certain requirements for power spectral uniformity and out-of-band emissions ("spectral mask"). Based on comprehensive laboratory test data submitted by the petitioners requesting the *Digital Declaratory Ruling*, the Commission determined that the

¹ Petition for Declaratory Ruling, August 31, 1998 ("Clarity Petition"). Clarity was acquired effective November 2, 1998 by Cisco Systems, Inc. ("Cisco").

² *Request for Declaratory Ruling on the Use of Digital Modulation by Multipoint Distribution Service and Instructional Television Fixed Service Stations, Declaratory Ruling and Order*, 11 FCC Rcd 18839 (1996) (hereinafter *Digital Declaratory Ruling*) (petitions for clarification and partial reconsideration pending).

interference potentials of Vestigial Sideband Modulation ("VSB") and Quadrature Amplitude Modulation ("QAM") were no greater than that of NTSC analog video modulation, and these modulation formats were adopted to be routinely authorized up to densities of 8-VSB and 64-QAM.

With respect to the spectral mask, petitioners sought, and the Commission granted on an interim basis, an amendment to the emission mask for MDS and ITFS stations using VSB and QAM to account for the significant difference between the spectral occupancy pattern of these emissions and the spectral occupancy of the NTSC analog video emission.³ Additionally, with respect to the spectral occupancy of these digital emissions, the Commission set out a requirement in the *Digital Declaratory Ruling* that the power spectral density be "substantially uniform" across the occupied bandwidth, including at times when no data (input signal) is applied to the transmitter.⁴

3. In the *MDS & ITFS Two-Way Order*, the Commission, *inter alia*, amended its Rules for the MDS and ITFS services to permit the regular use of Quadrature Phase Shift Keying ("QPSK") modulation and Code Division Multiple Access ("CDMA") modulation.⁵ This action was based on data and information submitted by ADC Telecommunications Corp. et al. ("ADC") in a petition for declaratory ruling requesting the addition of these digital modulation formats for use at MDS and ITFS stations.⁶ Those petitioners argued, and the Commission agreed, that QPSK was essentially an alternative designation for the already-permissible 4-QAM. With respect to CDMA, petitioners submitted the results of extensive laboratory testing which showed that CDMA presented essentially the same potential for interference to NTSC signals as do VSB and QAM, and therefore could be approved subject to the same technical restrictions applying to VSB and QAM. The Commission noted that it would "continue our policy of authorizing the use of other digital modulation formats where such use can be demonstrated to be within the confines of the interference protection standards for the MDS and ITFS services"; *i.e.*, desired-to-undesired signal strength ratios of 45 dB for cochannel stations and 0 dB for adjacent channel stations.

³ *Id.* at 18854. Subsequently, this mask was modified slightly when the Commission amended its Rules to expand significantly the scope of permissible two-way communications in the Multipoint Distribution Service and the Instructional Television Fixed Service. See *Amendment of Parts 21 and 74 to Enable Multipoint Distribution Service and Instructional Television Fixed Service Licensees to Engage in Fixed Two-Way Transmissions, Report and Order*, 13 FCC Rcd 19112, 19123-27 (1998) (hereinafter *MDS & ITFS Two-Way Order*).

⁴ 11 FCC Rcd at 18857.

⁵ 13 FCC Rcd at 19121-23. The Commission also formally amended its Rules to implement the provisions of the *Digital Declaratory Ruling* which regularized use of QAM and VSB in these services.

⁶ Request for Declaratory Ruling on the Use of Code Division Multiple Access and Quadrature Phase Shift Keying Digital Modulation by Multipoint Distribution Service and Instructional Television Fixed Service Stations, December 2, 1997.

CLARITY PETITION & COMMENTS

4. In its petition, Clarity submits that OFDM offers performance features not available in other digital modulations, specifically, the means for "achieving very high data rates in severe multipath conditions."⁷ OFDM is generated by the creation of multiple signals (carriers) within an authorized MDS or ITFS channel, each of which carrier is modulated with a portion of the information being transmitted. The signal modulating each of the carriers is typically a form of QAM, e.g. QPSK, 16-QAM or 64-QAM. The amplitudes and spacings of the carriers are configured such that the spectral energy of each carrier is significantly attenuated at the frequencies of each of the two adjacent carriers. The modulating QAM signals can be coded in order to be more robust in the presence of multipath propagation and/or interference, and Clarity proposes the use of its proprietary coding schema, designated Vector OFDM ("VOFDM"). Clarity retained the engineering firm of Hardin & Associates ("Hardin") to evaluate OFDM and determine its compatibility with, and potential for interference to, NTSC analog television signals. In an attachment ("Hardin Study") to the Clarity Petition, Hardin found, using laboratory tests, that OFDM "easily complies" with the interference protection requirements of the Commission's Rules.⁸ Hardin's laboratory tests were designed to insure that the OFDM emissions complied with the mask required for digital MDS/ITFS emissions.⁹ Hardin's conclusions were based on evaluations of two different OFDM waveforms, one with 256 carriers modulated by 4-QAM and the other with 4096 carriers modulated by 64-QAM.

5. Comments on the Clarity Petition were submitted by PetroCom License Corp., UltimateCom Wireless, LLC and ADC, and reply comments were submitted by Cisco. All were supportive of the Clarity Petition. Cisco urged the Commission to act expeditiously, arguing that, in the near future, MDS and ITFS operators "will make decisions about digital equipment procurement and deployment" and that "uncertainty may unnecessarily disadvantage OFDM technology competing in the market with other digital modulation standards that the Commission has already approved."¹⁰

DISCUSSION

6. We agree with Cisco that prompt action on the Clarity Petition is warranted. The

⁷ Clarity Petition at 3.

⁸ Hardin Study at 8.

⁹ *Id.* at 6; see *MDS & ITFS Two-Way Order*, 13 FCC Rcd at 19123-27.

¹⁰ Reply Comments of Cisco Systems, Inc., November 23, 1998, at 2.

Commission's actions in the *MDS & ITFS Two-Way Order* enhanced significantly the ability of MDS and ITFS licensees to offer a broad range of communications services to the public. Many of these services, such as high speed wireless Internet access, will depend on the availability and use of sophisticated digital transmission facilities configured with differing modulation formats, depending on the service being offered, the bandwidth used, path lengths, line-of-sight conditions and many other factors. For this reason, we believe it is in the public interest to authorize the use of additional types of modulation when it can be demonstrated that the potential for interference will not exceed that provided by the existing protection standards in the Rules. We conclude that Clarity has met this requirement, and we therefore are granting its petition to add OFDM to the list of approved emissions for MDS and ITFS stations.

7. Specifically, based upon the Hardin laboratory test results, we will permit the use of OFDM modulation, coded or uncoded, so long as a minimum of 256 QAM-modulated carriers are used and the transmitted signal complies with the spectral mask and power limitations set out in our MDS and ITFS rules for digital emissions. It should be understood clearly that this action is an interim step in our overall consideration of the issue of digital modulation in the MDS and ITFS spectrum, as were our actions in granting approval for VSB, QAM, QPSK and CDMA, pending the establishment of permanent technical standards for MDS and ITFS digital operations. We also emphasize at this time that this Declaratory Ruling and Order and our actions with respect to digital modulation in the *Digital Declaratory Ruling* and in the *MDS & ITFS Two-Way Order* apply only to the MDS and ITFS services, and have *no* implications with respect to other services regulated by the Commission.

ORDERING CLAUSES

8. Accordingly, IT IS ORDERED that under the authority contained in Section 4(i) of the Communications Act of 1934, as amended, 47 U.S.C. § 154(i), and in Section 554(e) of the Administrative Procedure Act, 5 U.S.C. § 554(e), the Petition for Declaratory Ruling, on the use of OFDM modulation by MDS and ITFS stations, IS GRANTED to the extent specified above. This Declaratory Ruling and Order shall be effective upon its release and shall remain effective until adoption of rules governing digital transmissions in MDS and ITFS in a future rulemaking proceeding. See 47 C.F.R. §§ 1.4(b)(2) and 1.103. Nothing in this Declaratory Ruling and Order shall prejudice the outcome of such a rulemaking proceeding.

9. IT IS FURTHER ORDERED that the staff of the Mass Media Bureau shall send copies of this declaratory ruling to the parties filing formal comments by certified mail, return receipt requested.

FEDERAL COMMUNICATIONS COMMISSION

Roy J. Stewart
Chief, Mass Media Bureau